Propellant Flow Actuated Piezoelectric Rocket Engine Igniter, Phase II

Completed Technology Project (2011 - 2013)

Project Introduction

Under a Phase 1 effort, IES successfully developed and demonstrated a spark ignition concept where propellant flow drives a very simple fluid mechanical oscillator to excite a piezoelectric crystal. The Phase 1 effort exceeded expectations, with the device demonstrating reliable ignition of both hydrogen and propane fuels, and achieving in excess of 1 million impact cycles (40,000 start cycles) during fatigue testing without measureable degradation. Several spin-off concepts were also identified that provide additional options for improving spark ignition system design. For Phase 2, IES proposes an accelerated, 18 month effort to refine design concepts and analysis tools, and then develop specific ignition system designs for two customer applications, with the intention of having these ignition systems demonstrated in engine ground testing during Phase 2 and ready to start flight qualification immediately following the Phase 2 effort. Both customers (United Launch Alliance and Pratt Whitney Rocketdyne) have expressed interest and commitment in participating in the Phase 2 activity, making engines and facilities available for development testing, and integrating any resulting viable products into their flight engines. The ULA application is a new gaseous bipropellant H2/O2 attitude control thruster, for which the piezoelectric igniter is ideal as a simple, direct ignition source. The PWR application is for an evolved RL-10 study currently underway, for which the piezoelectric system might be scaled up or used as a pilot igniter for a torch, or make use of another spin-off concept that was identified during the Phase 1 effort. The timing of this Phase 2 effort coincides perfectly with near term needs of both these customers, as well as for other small engine applications in work to replace catalytic hydrazine engines with bi-propellant engines that will require a simple and reliable ignition source.

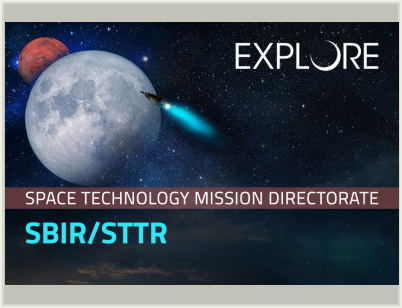

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Table of Contents

Propellant Flow Actuated Piezoelectric Rocket Engine Igniter, Phase II

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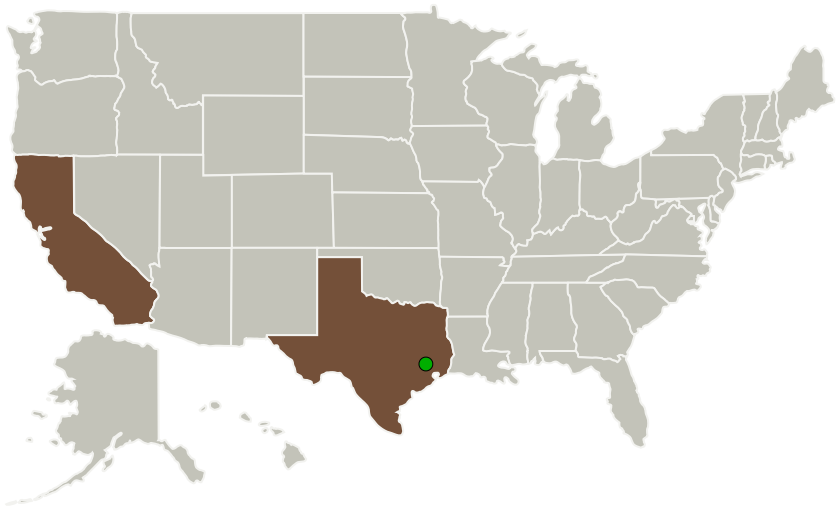
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Innovative Engineering Solutions	Lead Organization	Industry	Murrieta, California
Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations	
California	Texas

Project Transitions

June 2011: Project Start

May 2013: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139240)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Innovative Engineering Solutions

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Mark A Wollen

Co-Investigator:

Mark Wollen

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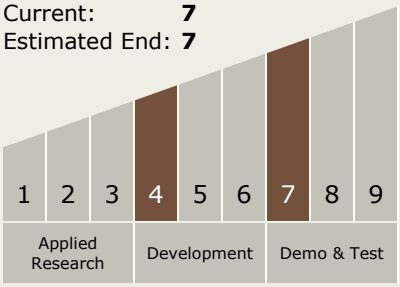
Completed Technology Project (2011 - 2013)

Technology Maturity (TRL)

Start: **4**
Current: **7**
Estimated End: **7**



Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.3 Cryogenic

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System